

$\bar{\nu}_e \rightarrow \bar{\nu}_e$ Daya Bay $\bar{\nu}_e$ disappearance

- Four times more statistics (621 days) than the previously published result
- Over 1 million antineutrinos detected (150k in the far detectors)
- Most precise measurement of $\sin^2(2\theta_{13})$ (6%)
- Shape distortion agrees with oscillation prediction

$$\sin^2 2\theta_{13} = 0.084^{+0.005}_{-0.005}$$

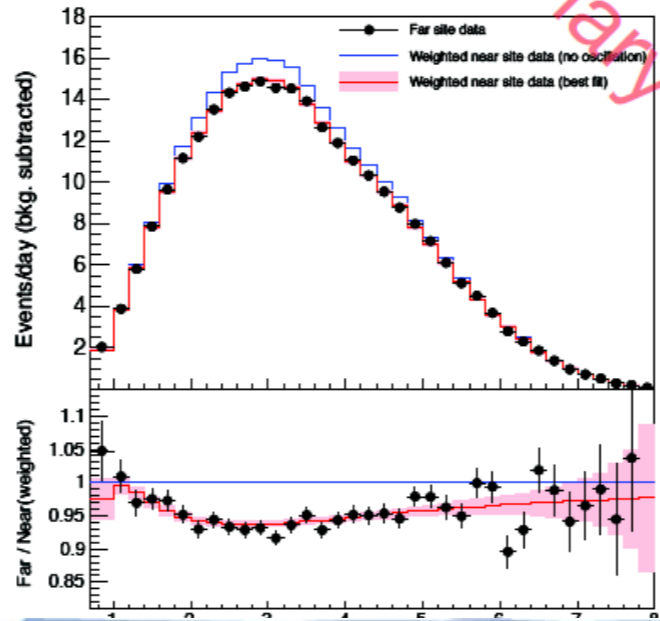
$$|\Delta m_{ee}^2| = 2.44^{+0.10}_{-0.11} \times 10^{-3} \text{eV}^2$$

$$\chi^2/NDF = 134.7/146$$

$$\text{RENO } \sin^2 2\theta_{13} = 0.101 \pm 0.013$$

$$\text{Double Chooz } \sin^2 2\theta_{13} = 0.090^{+0.032}_{-0.029}$$

Marco Zito-ICHEP 2014



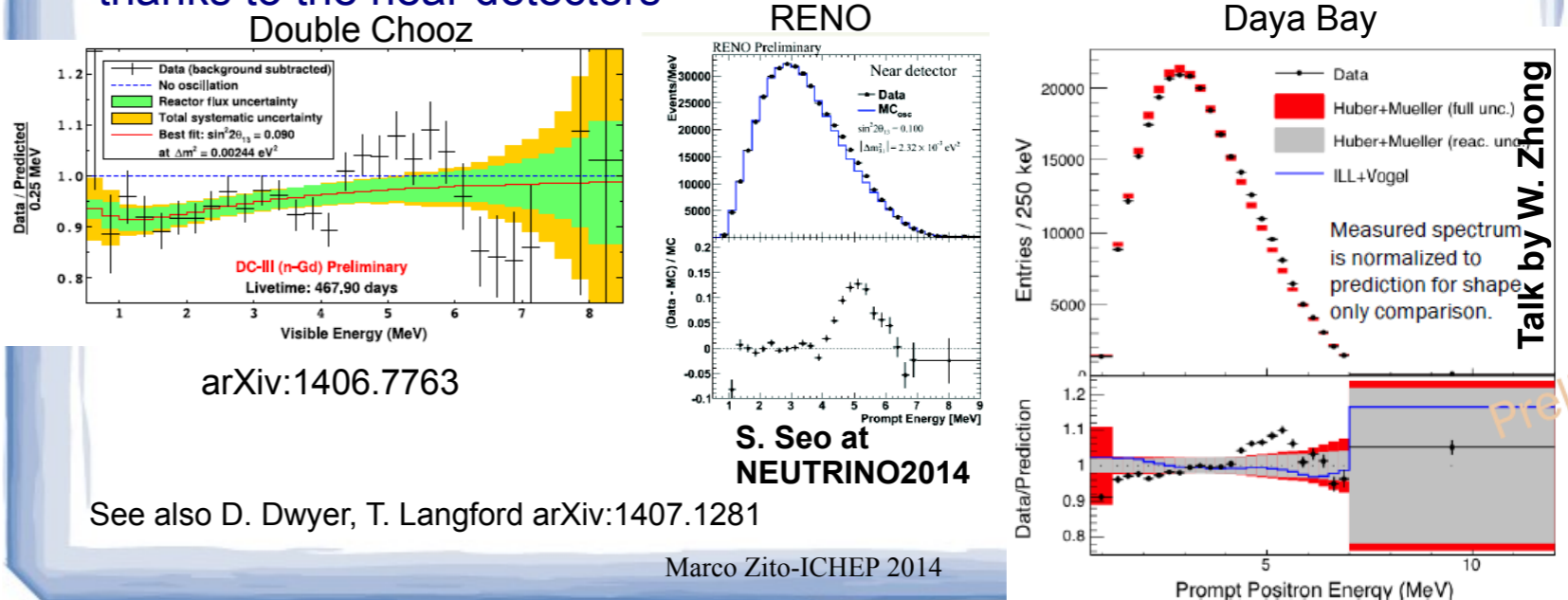
- Progrès récents autour de θ_{13} (RENO, Double Chooz, Daya Bay), même si le flux des neutrinos venant des réacteurs pas parfaitement compris...
- Les ajustements globaux commencent à contraindre la phase liée à la violation de CP (asymétrie neutrino-antineutrino)

Understanding the reactor neutrino flux

- A distortion in the spectrum was observed by Double Chooz, RENO and Daya Bay
- Preliminary studies disfavor background and energy-scale as an explanation
- According to preliminary studies the θ_{13} measurement is not affected thanks to the near detectors

ICHEP 2014

Parameter	Best fit	Precision(%)
$\sin^2 \theta_{12}$	$0.304^{+0.012}_{-0.012}$	4
$\sin^2 \theta_{23}$	$0.451^{+0.001}_{-0.001} \oplus 0.577^{+0.027}_{-0.035}$	7.5
$\sin^2 \theta_{13}$	$0.0219^{+0.0010}_{-0.0011}$	5
Δm_{21}^2	$7.50^{+0.19}_{-0.17}$	2.3
10^{-5}eV^2		
Δm_{31}^2 (N)	$+2.458^{+0.002}_{-0.002}$	2
10^{-3}eV^2		
Δm_{32}^2 (I)	$-2.448^{+0.047}_{-0.047}$	2
10^{-3}eV^2		
$\delta_{CP} / ^\circ$	251^{+67}_{-59}	



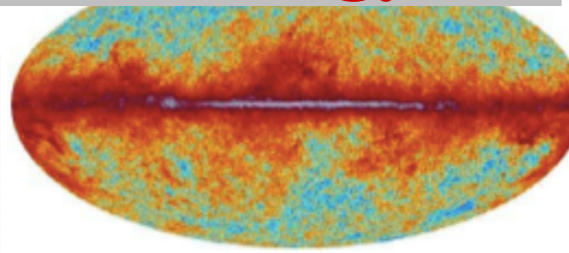
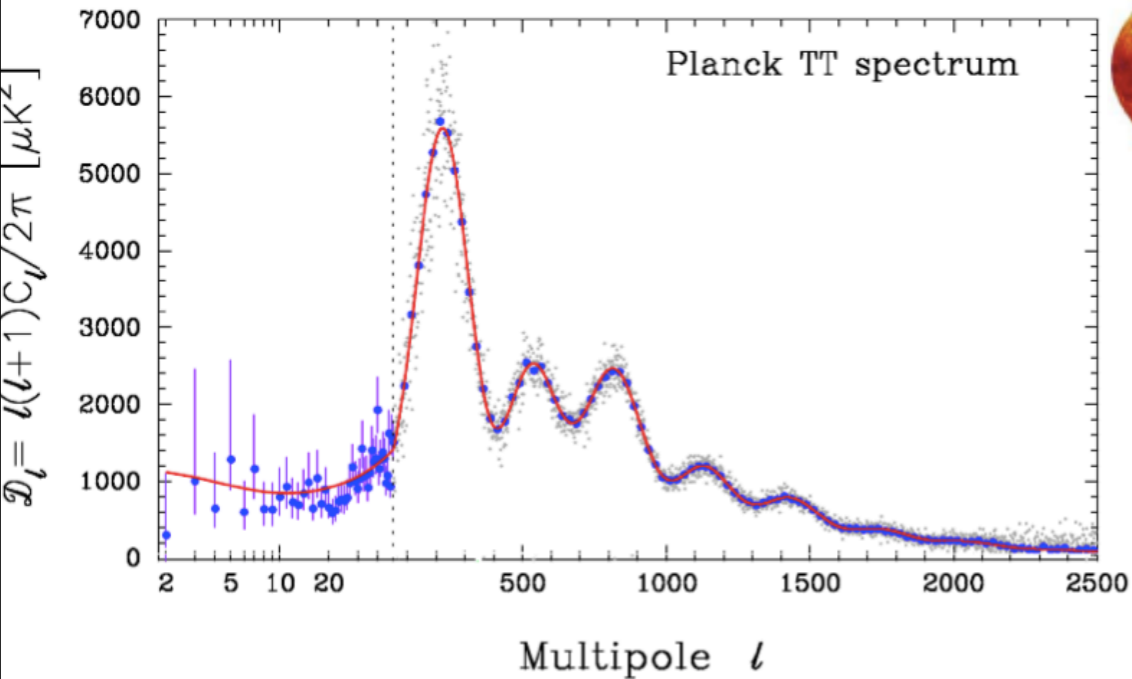
arXiv:1406.7763

See also D. Dwyer, T. Langford arXiv:1407.1281

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Talk by W. Zhong

Neutrino Properties from Cosmology



success of Λ CDM
 + 3 active neutrinos
 + $\Sigma m_\nu \geq 0.06$ eV
 (from oscillations)

- Contraintes sur la masse de neutrino par recherche directe (spectre désintégration beta)...
- ... mais aussi contraintes cosmologiques en lien avec le CMB observé par Planck, et autres observations astrophysiques

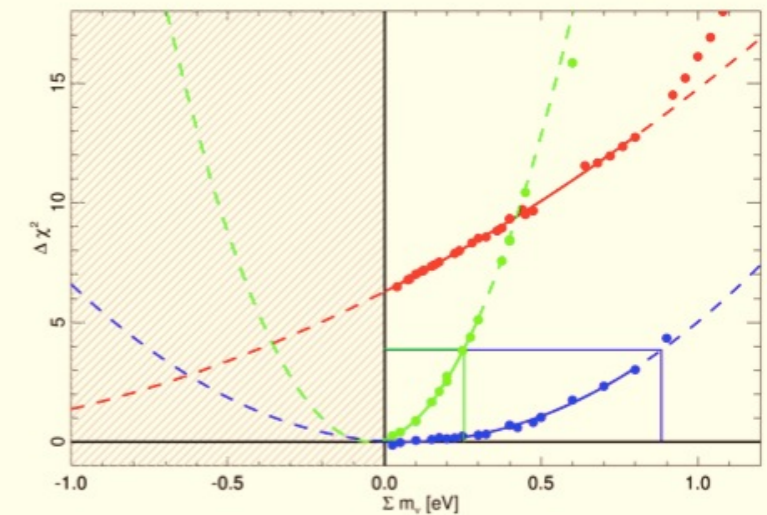
maps $\Rightarrow C_\ell(\vec{\Omega}) \Rightarrow \mathcal{L}_{Planck}(C_\ell, \psi)$

$\vec{\Omega}$: cosmological parameters, ψ : nuisances)

O(40) parameters \leftrightarrow beware of degeneracies...

\rightarrow limits on Σm_ν and N_{eff}

- frequentist analysis: Planck alone gives an *artificially low* results
- +lensing $\Sigma m_\nu < 0.85$ eV
- we use Feldman-Cousins prescription
- +BAO: $\Sigma m_\nu < 0.26$ eV

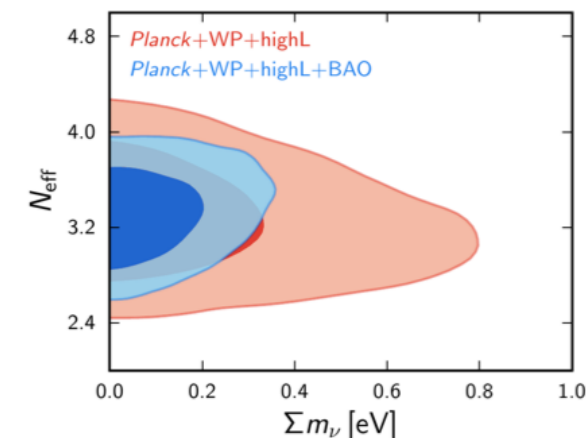


Planck+WP+High l + lensing + BAO

M. Spinelli @ NEUTRINO 2014

Contraintes nettement plus fortes que physique des particules, mais liées au modèle cosmologique employé...

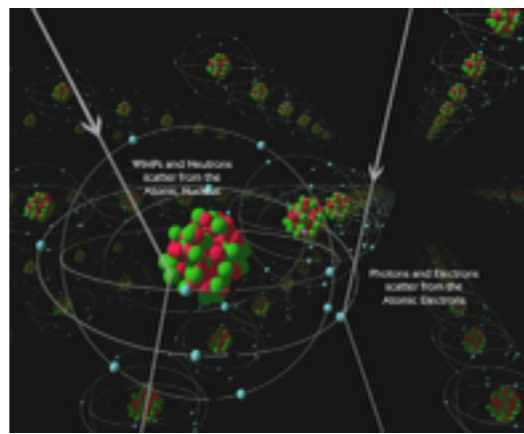
$N_{eff} = 3.32 \pm 0.27$ (68%CL)
 $\Sigma m_\nu < 0.28$ eV (95%CL)



HOW TO CATCH A WIMP

1. Direct detection (scattering XS)

- Nuclear (atomic) recoils from elastic scattering
- A- & J-dependence, annual modulation, directionality
- Galactic DM at the Sun's position - our DM!
- Mass measurement (if not too heavy)

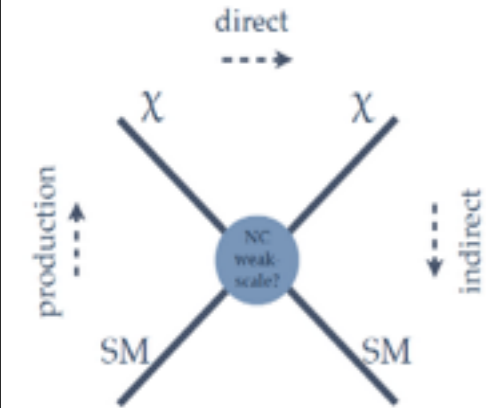


2. Indirect detection (decay, annihilation XS)

- High-energy cosmic-rays, γ -rays, neutrinos, etc.
- Over-dense regions, annihilation signal $\propto n^2$
- Very challenging backgrounds

3. Accelerator searches (production XS)

- MET, mono-X, dark photons, etc.
- Mass measurement may be poor at least initially
- Can it establish that new particle is the DM?

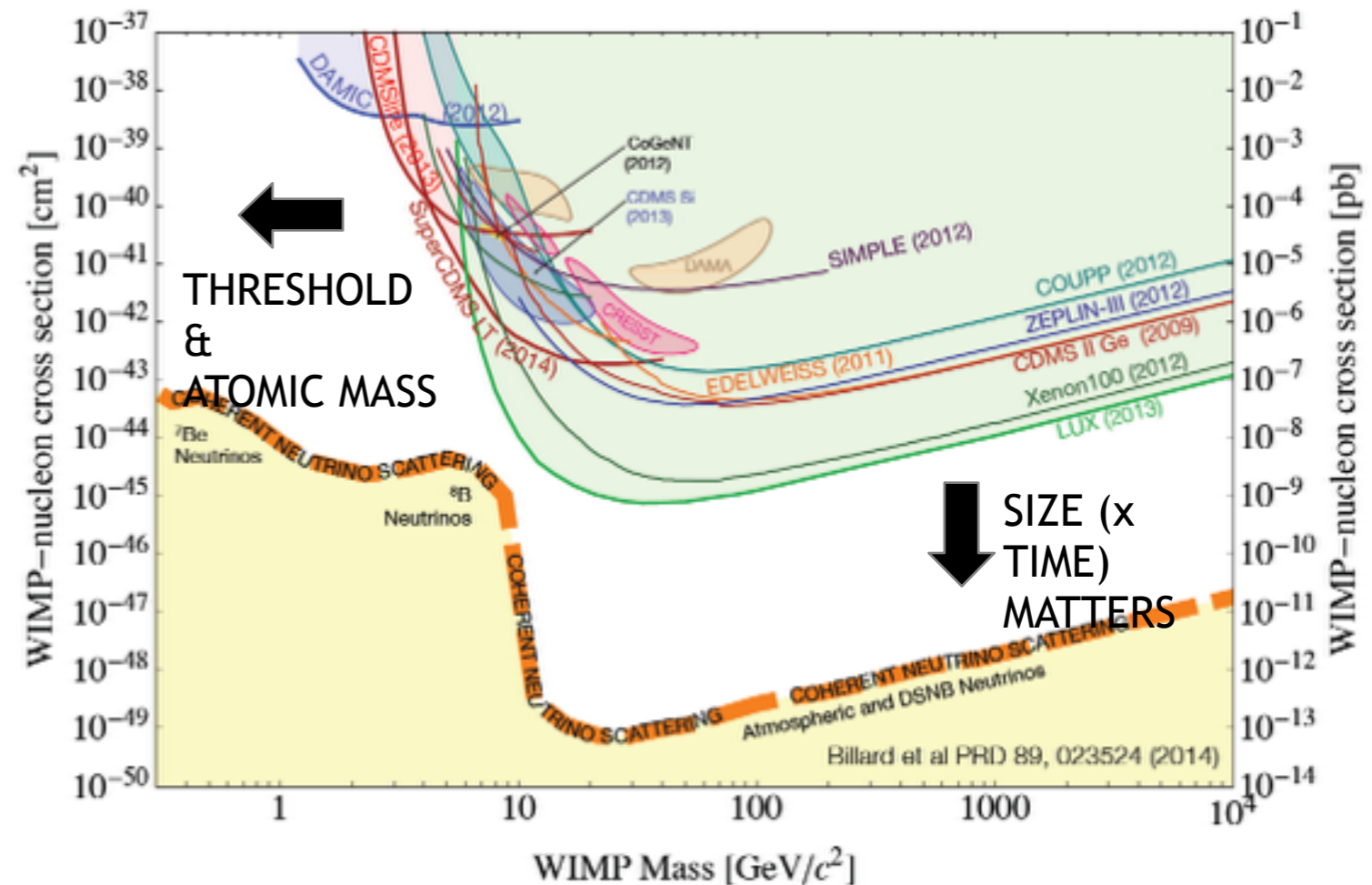


La recherche de matière noire peut se faire par la production directe en collisionneur, par la détection de sa désintégration dans l'espace, ou par son interaction avec des détecteurs (sur des tailles et des principes proches de ceux pour les neutrinos)

PRESENT STATUS

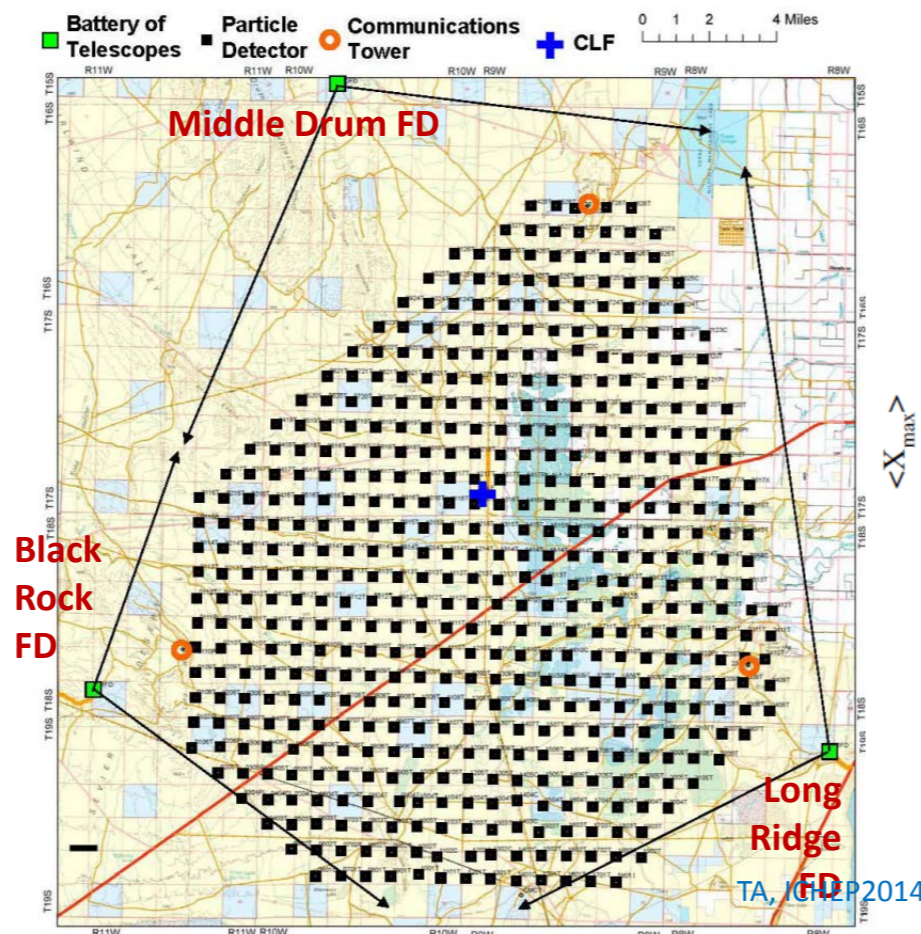
H. ARAUJO / ICHEP 2014

Plusieurs annonces de détection directe, toutes réfutées par LUX (Xenon liquide, Homestake, USA) — des détecteurs plus sensibles sont en cours de conception

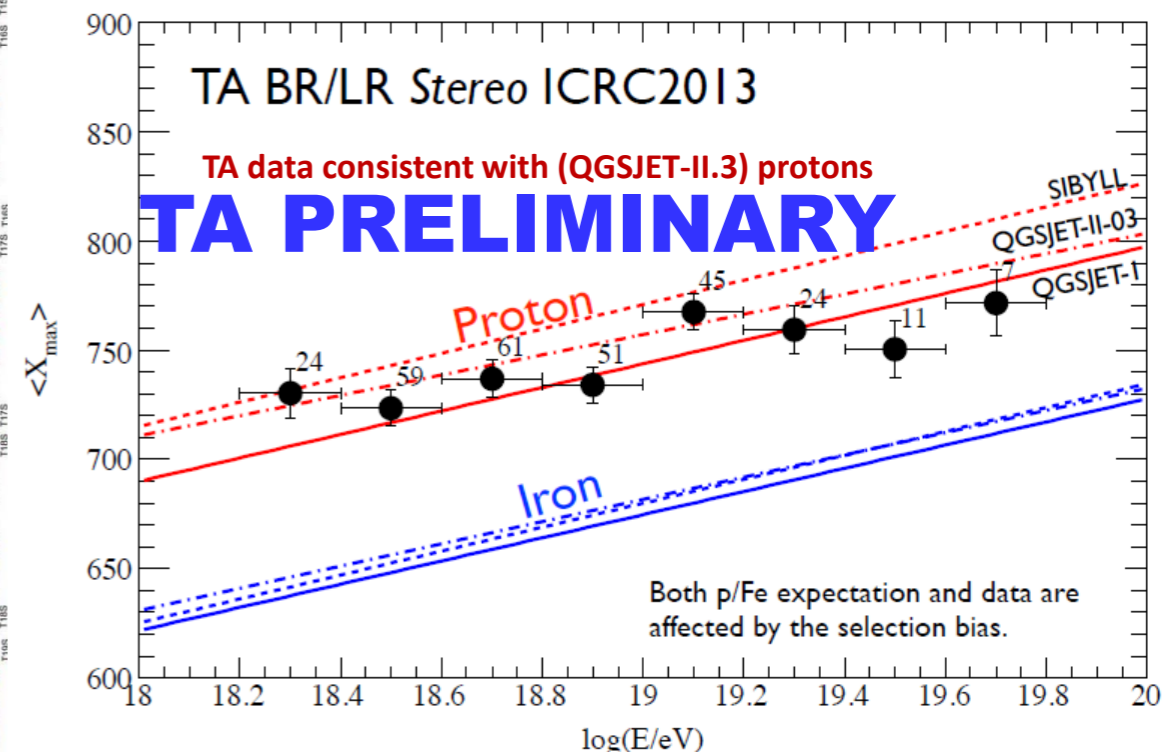


TA is a hybrid experiment

- 507 scintillation counters surface detector (SD)
 - Area: 730 km².
- 3 fluorescence detector (FD) stations
 - 12 + 12 + 14 telescopes (~16° × 14° each)
 - Located at the corners of the SD array



5 years TA stereo FD data



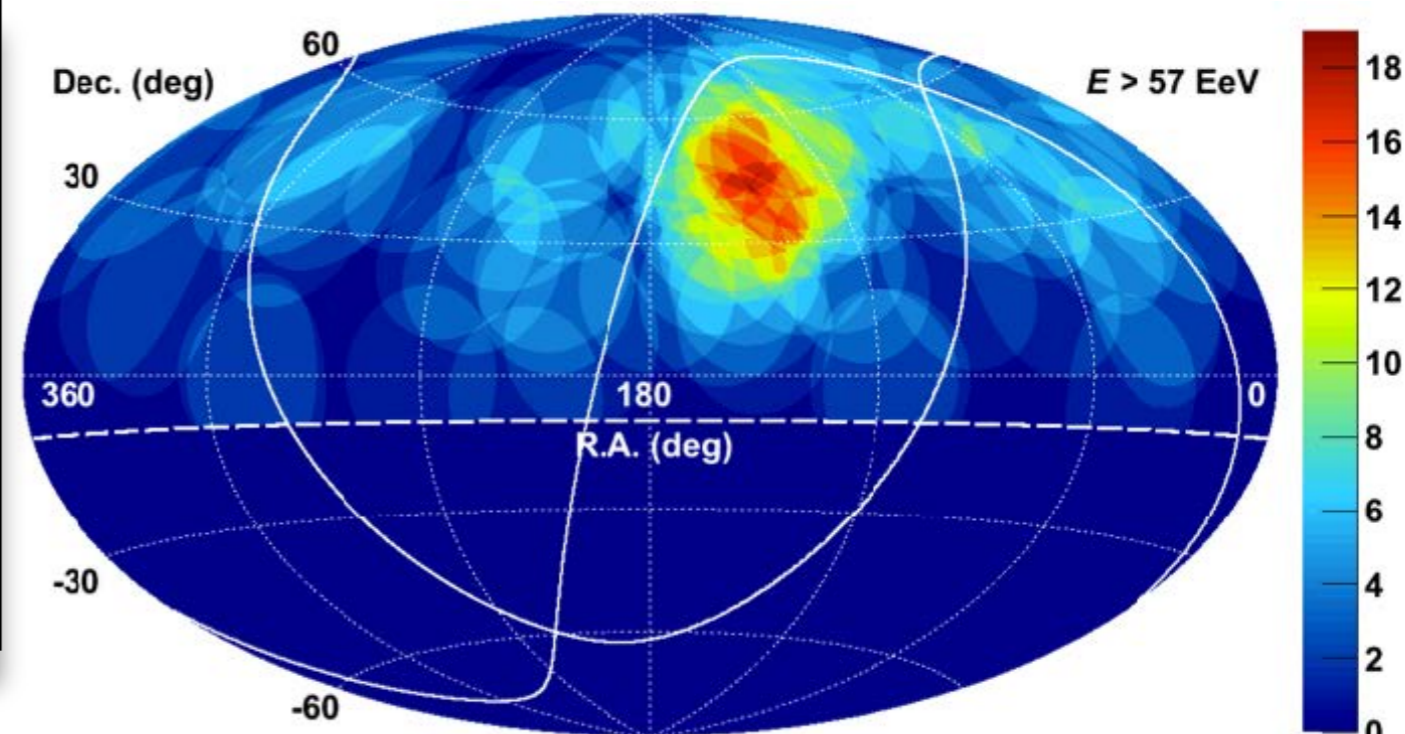
TA, ICHEP2014

72 events zenith angle $< 55^\circ$, with $E > 5.7 \times 10^{19}$ eV

Colors: oversampling with 20° (radius) circles

19 events in circle centered at R:A: = 146.7° , Dec: = 43.2°

- Telescope Array (Utah, USA) marche sur les traces de Pierre Auger (autre hémisphère)
- Des résultats sur la composition des rayons cosmique de haute énergie (protons) et accumulation d'évènements dans un point chaud... à confirmer avec plus de données et plus de détecteurs



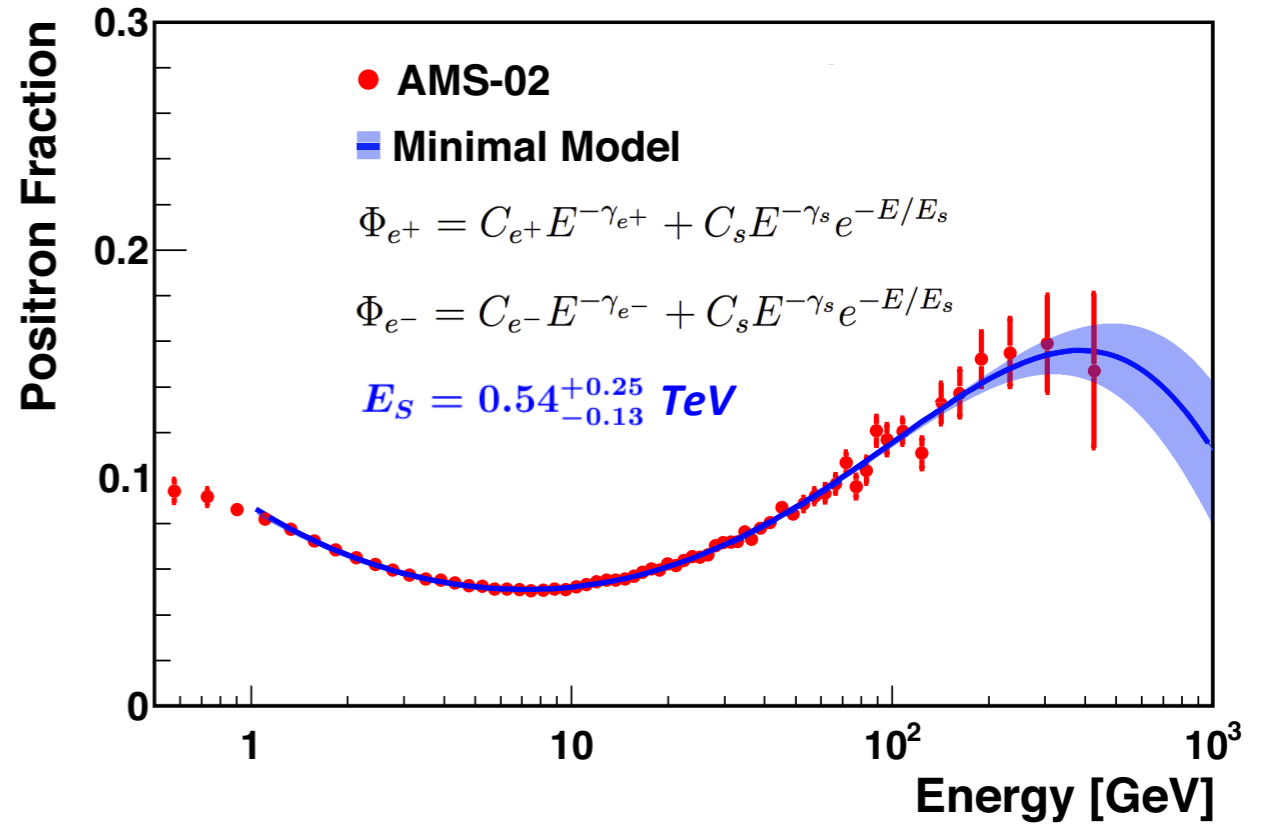
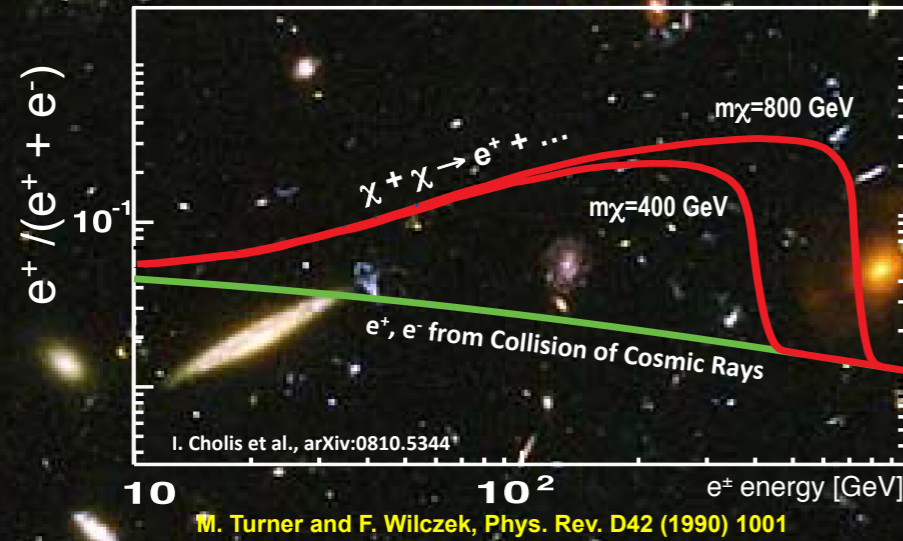
20° circle = ~6% of northern sky, but 19 of 72 events are contained in "hotspot"

Positron Fraction

Electrons, Positrons constitute <1% of CR Particles

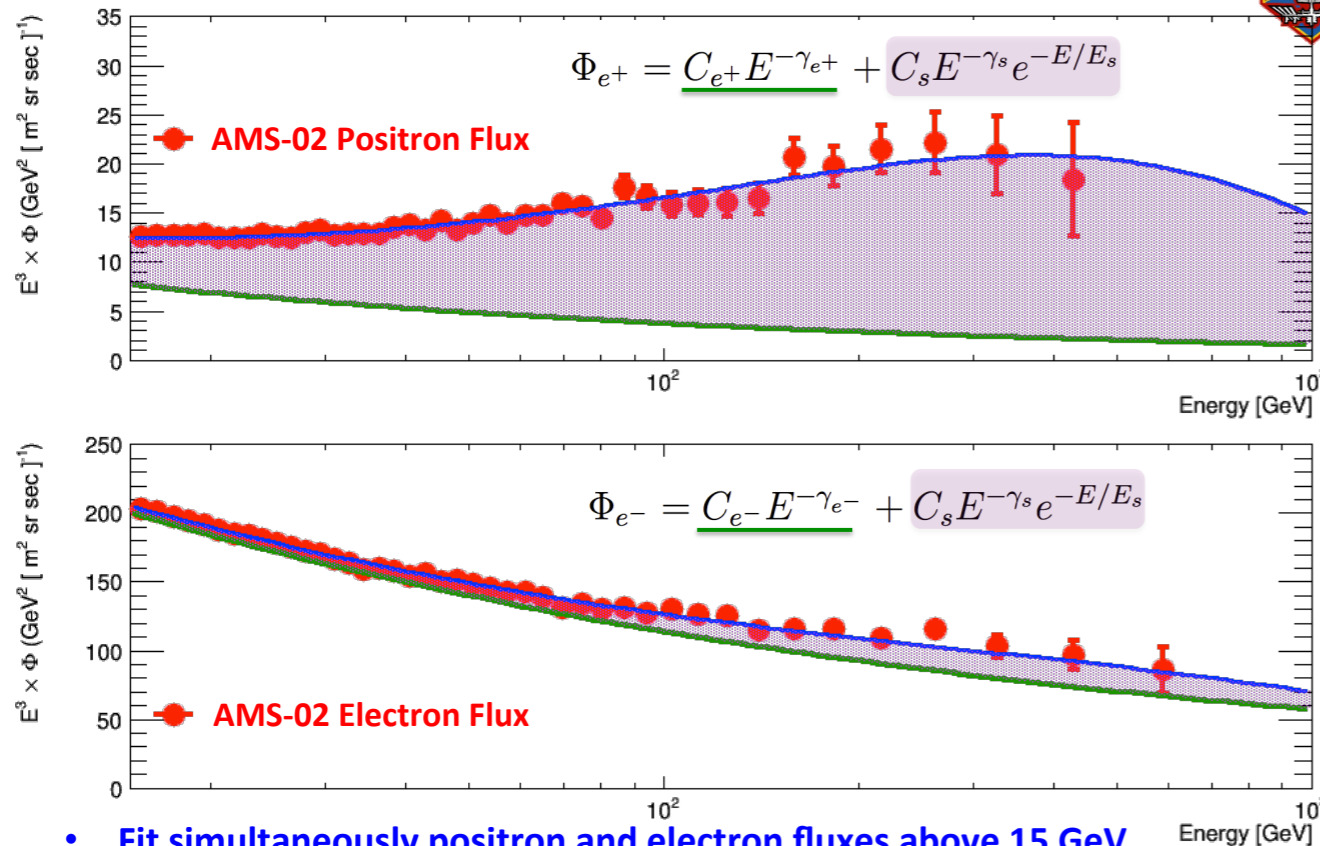
“Known source” of e^+ : collision of CR particles with ISM

Annihilation of Dark Matter, Pulsars, ... may produce additional e^+ , ...



Positron fraction not compatible with only diffuse power law component
 Source term is needed to describe the behaviour
 Cutoff energy of 0.54 TeV

Minimal Model fitted to Positron and Electron Fluxes

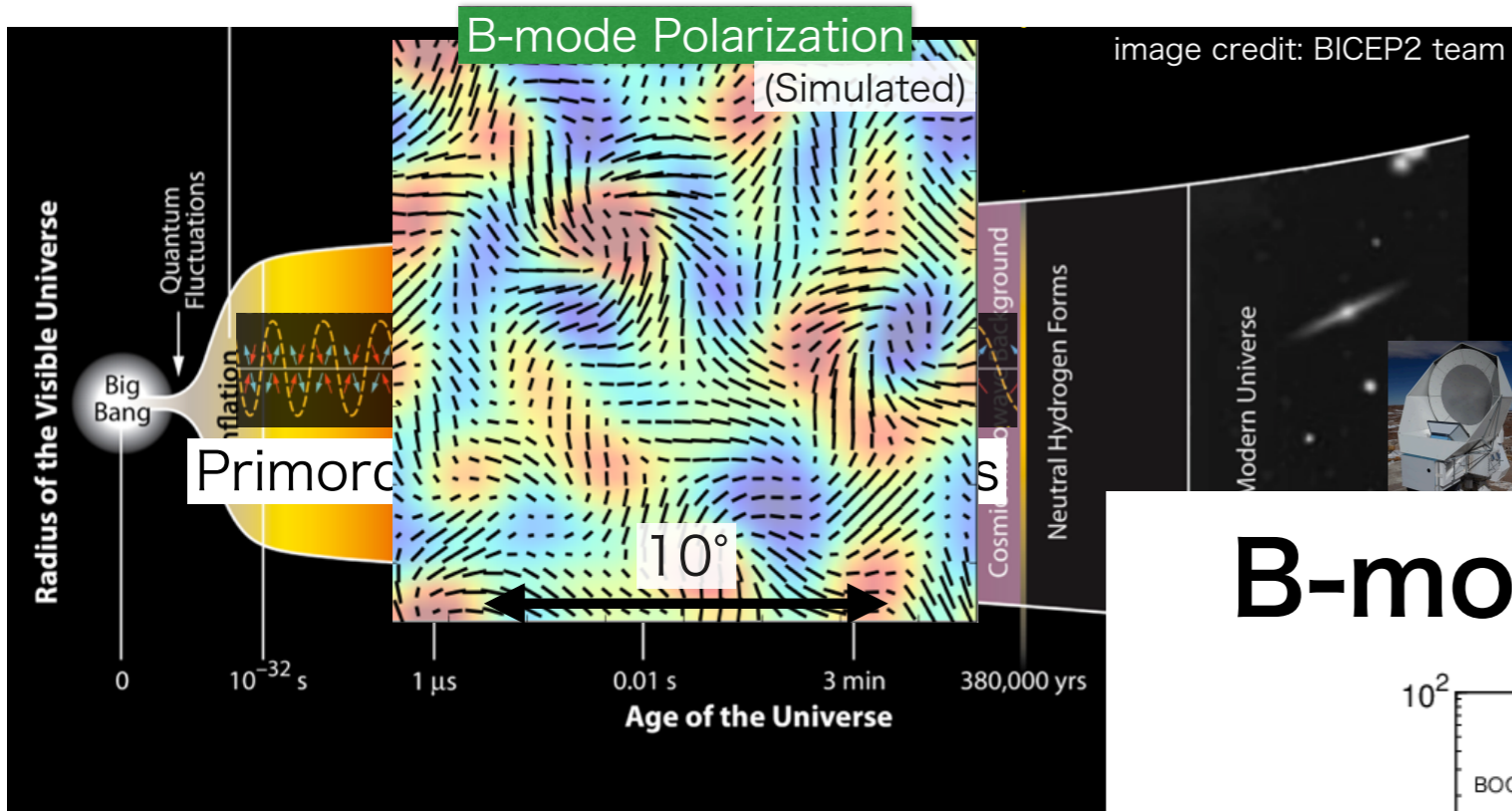


- Fit simultaneously positron and electron fluxes above 15 GeV
- Positron and electron fluxes not compatible with only diffuse component
- Source term is needed to describe the behaviour

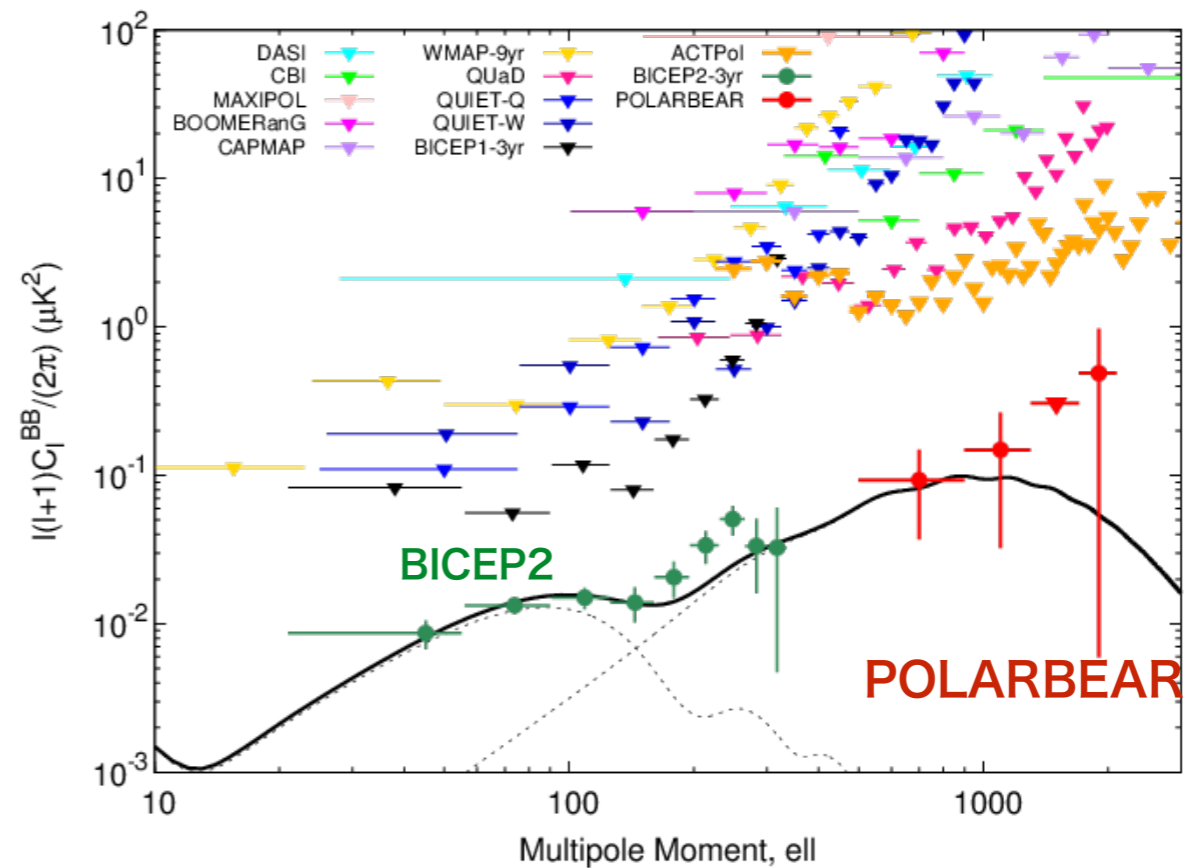
- AMS (embarqué sur Station Spatiale Internationale) mesure la composition des rayons cosmiques
- Nouveaux résultats sur la fraction d'électron et de positron à 100 GeV-1 TeV
- Nécessite un terme de source pour décrire le comportement... dont l'origine reste à identifier (matière noire, pulsar...)

CMB B-mode Polarization (Primordial)

Quantum fluctuations during inflation are predicted to be imprinted as degree-scale curl-like polarization pattern (B-mode)



B-mode Power Spectrum



- Etude de la polarisation du fonds diffus cosmologique
- BICEP2, puis POLARBEAR commencent à faire des mesures sur les modes B (et plus seulement des contraintes)... en attendant PLANCK

POLARBEAR is starting large sky patch observations for primordial B-mode measurement. ₂₃



**A la prochaine édition,
ICHEP 2016, à Chicago (USA)**

**ou dans un an,
pour Lepton-Photon 2015 à Ljubljana (Slovénie)
ou EPS-HEP 2015 à Vienne (Autriche) !**